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IDENTIFICATION AND MANAGEMENT OF NONPOINT SOURCES OF POLLUTION

Nonpoint pollution accounts for more than 50% of the total water quality problem. Yet, until recently, it went unnoticed and all pollution abatement efforts were aimed at controlling point sources of pollution. Nonpoint pollution can be correlated with land use and with disturbing activities taking place on the land. The *Best Management Practices* are focused mainly on keeping the potential pollutants on land rather than traditional collection and treatment.

1. INTRODUCTION

Until recently all pollution abatement efforts were aimed at controlling sewage and wastewater discharges into receiving waters. Nonpoint pollution—that is pollution from stormwater and runoff—was not recognized generally until the late 1960's. In many areas of the world emphasizing industrial and agricultural growth, e.g., the United States at the beginning of this century, most obvious signs of nonpoint pollution such as smoking industrial stacks, open mine pits, mine spoil deposits, and construction are considered signs of progress rather than pollution. Engineering design practices under these conditions considered runoff and stormwater as dilution of sewage and replacement of treatment. When the dilution ratio of stormwater and sewage in combined sewers reached a certain "safe" ratio—ranging from 4:1 to 8:1—the mixture of untreated sewage and stormwater was allowed to overflow into receiving waters without any treatment.

In non-urban areas, soil loss—one of the primary components of surface runoff pollution—has been recognized as harmfull and often devastating to agricultural production since the "dust storms" occurring in the United States in 1920's to 1930's. However, the water pollution impact of soil loss and agricultural activities, in general, was not realized.

With enormous amounts of financial resources being spent on clearing up point sources of pollution in the U.S., it has been recently recognized that this effort only may not bring about dramatic water quality improvements, especially when dealing with lakes, reser-

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voirs, estuaries, as well as many streams. Significant amounts of pollution reach surface water bodies from the use of land and watershed modifications by man. The term *nonpoint* or *diffuse sources* defines then these sources of pollution. Nonpoint sources of pollution account roughly for more than 50% of the total water quality problem. In many areas, nonpoint pollution such as runoff from cropland, urban stormwater, mining, and runoff from construction sites are becoming major water quality problem (ALEXANDER [1]).

The problem of nonpoint pollution does not only involve the "traditional" pollution parameters such as suspended solids, biochemical oxygen demand (BOD), dissolved oxygen (D.O.) and nutrients (nitrogen and phosphorus). In fact, some of the most serious nonpoint pollution problems do not have a parallel in the traditional point source oriented environmental pollution control area. These problems include contamination of Great Lakes fish by PCBs (Polychlorinated bi-phenyls), acid rain, and pesticide contamination of surface water bodies and aquatic biota.

An interesting feature of nonpoint pollution is that—with few exceptions—the bulk of pollution is carried by surface runoff. Thus, the areas where surface runoff originates—called hydrologically active areas—also are sources of nonpoint pollution and should be subject to control and management. Hydrologically active areas include impervious urban and roadway surfaces, areas with a high groundwater table and/or tight soils, and frozen soils with spring rains. It has been found that during even large storms only a small part of a watershed contributes to surface runoff and be counted as a source of pollution. The term *hazardous land uses and hazardous areas* has been used to describe hydrologically active areas that contribute to the highest amount of pollution.

2. IDENTIFICATION AND CHARACTERISTICS OF NONPOINT POLLUTION

The character of nonpoint pollution differs from that from point sources. The differences can be summarized as follows (NOVOTNY and CHESTERS [11]):

POINT SOURCES	NONPOINT SOURCES
Fairly steady flow and quality. Variability ranges less than one order of magnitude.	Highly dynamic in random intermittent intervals. Variability ranges often more than several orders of magnitude.
The magnitude of pollution is not directly related to meteorological factors.	Magnitude of pollution is closely correlated to meteorological variables such as precipitation.
The most severe impact during a low flow summer period.	The most severe impact during or following a storm event.
Enter receiving waters at identifiable points.	Point of entry often cannot be identified or located.
Pollution orginates mostly from repetitive operations (industrial and urban activities) on small units of land.	Pollution mostly derived from consecutive operations on large units of land.

2.1. PRIMARY PARAMETERS OF INTEREST:

POINT SOURCES	NONPOINT SOURCES
BOD, dissolved oxygen, nutrients, suspended solids, toxic substances.	Sediment, nutrients, organic chemicals, toxic metals, pH, dissolved oxygen.

2.2. RURAL NONPOINT SOURCES

These sources are mostly related to agricultural and silvicultural activities. Agricultural pollutants have their origin in fertilizer use (e.g. application of manure on frozen land, overfertilization by chemical nutrients), pesticide application, and, generally, the primary causes are agricultural methods of disturbing soils by tillage (agricultural lands) or logging (silvicultural lands). Several other factors also affect pollution loading: soil type, climate, management practices, and topography. Land uses that produce the most pollution per

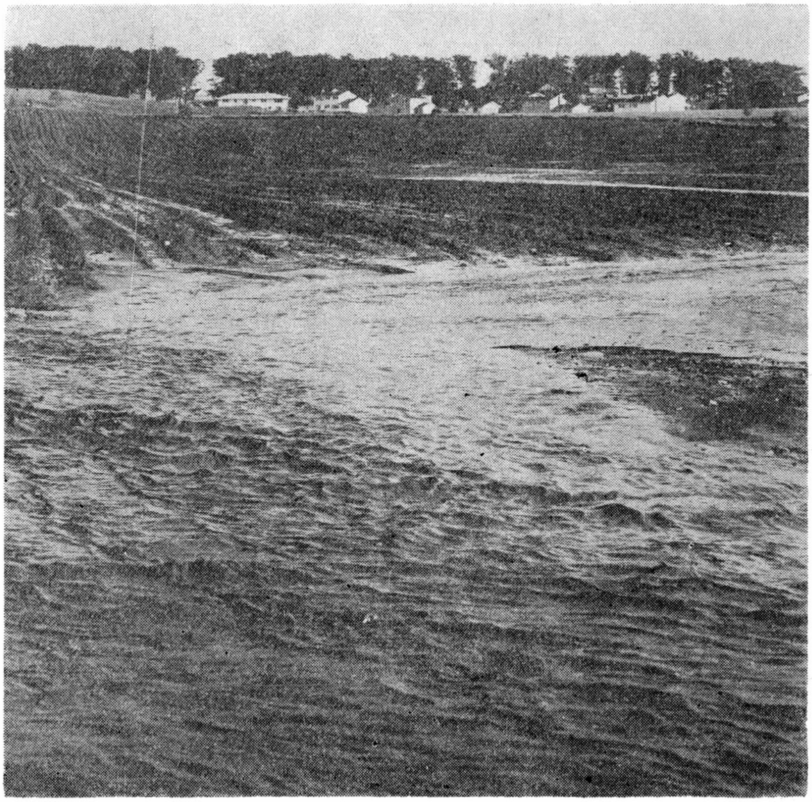

Fig. 1. Pollution generating runoff from agricultural lands
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Rys. 1. Spływ powierzchniowy z terenów uprawnych
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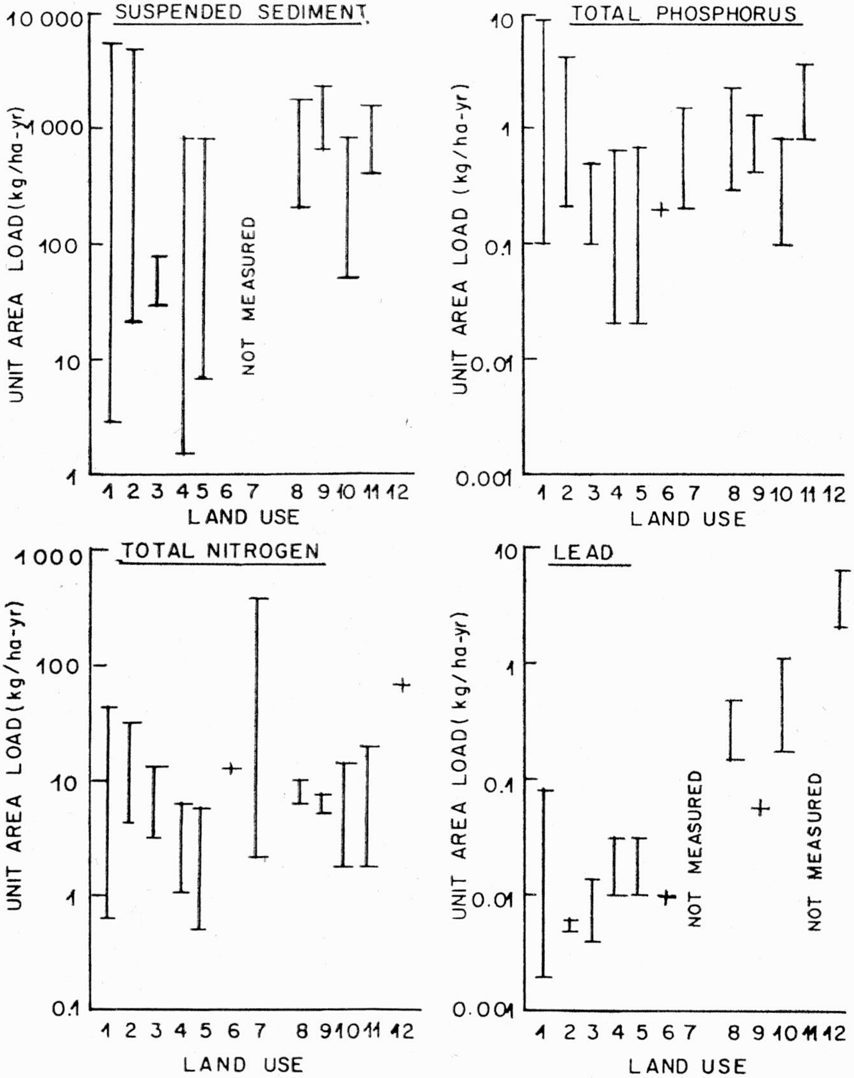


Fig. 2. Ranges of unit loads of pollutants from various land uses within the Great Lakes basin (CHESTERS et al. [4])

Land uses: 1. general agriculture, 2. cropland, 3. improved pasture, 4. forested/wooded, 5. idle/perennial, 5. sewage sludge disposal, 7. spray irrigation, 8. general urban, 9. residential, 10. commercial, 11. industrial, 12. developing urban (construction)

Rys. 2. Zakresy ładunków jednostkowych zanieczyszczeń z różnych użytków rolnych w Great Lakes (CHESTERS et al. [4])

Użytki rolne: 1. ogólne uprawy, 2. obszary uprawne, 3. ulepszone pastwisko, 4. tereny zalesione, 5. nieużytki, 6. użytki, na których zachodzi usuwanie osadu ściekowego, 7. obszary nawadniane przez rozdeszczanie, 8. tereny zabudowane, 9. tereny zamieszkałe, 10. tereny handlowe, 11. tereny przemysłowe, 12. rozwijająca się zabudowa (budowa) unit area in the United States are animal feedlot operations and farming on steep slopes. Forested lands pastures, on the other hand, produce the least amount of pollution that is approaching background levels.

The pollutional impact on receiving waters depends on the distance of the source from the nearest concentrated flow—stream—and on the processes taking place during the overland flow phase of the pollutant transport. Figure 1 shows a typical example of pollution generating runoff from agricultural lands. The ranges of average loads (pollution generation from some rural nonpoint sources) are presented in tab. 1 and fig. 2.

Table 1

Estimated magnitudes of pollutant contributions to surface waters from selected nonpoint sources in the conterminous U.S.A. (BAILEY and WADDEL [3])
Udział wskaźników skażenia wód powierzchniowych z wybranych niepunktowych źródeł w USA (BAILEY i WADDEL [3])

Nonpint source category	Sediment	BOD_5	Nitrogen	Phosphorus
	million tons/yr			
Cropland	1700	8.2	3.9	1.42
Pasture and range	1190	4.5	2.3	0.98
Forest	232	0.73	0.35	0.08
Construction	179			
Mining	54			
Urban runoff	18	0.45	0.13	0.017
Rural roadways	2	0.004	0.0005	0.001
Small feedlots	2	0.05	0.15	0.032
Land fills		0.27	0.024	
Subtotal	3377	14.2	6.9	2.5
Natural (background) loadings	1150	4.6	2.3	1.0
Total	4527	18.8	9.2	3.5

2.3. URBAN NONPOINT SOURCES

Urbanization and related hydrologic modifications cause increased pollution loadings that are significantly above the original or background levels (fig. 3). The source of urban nonpoint pollution varies considerably ranging from urban bird and pet population, domestic and industrial heating, street litter accumulation, air pollution fallout, tire wear of vehicles, abrasion of road surfaces by traffic, street salting practices, construction activities (fig. 4), and industrial and commercial operations. Urban nonpoint pollution contains many dangerous contaminants such as lead, zinc, asbestos, PCBs, oil, and grease (tab. 2).

Three basic urban land uses exist in the U.S.*: residential, commercial, and industrial

* In the United States due to zoning restrictions conflicting land uses are not permitted in the same area.

Fig. 3. High impreviousness of urban centers is a primary cause of elevated nonpoint pollution loadings that may contain many hazardous pollutants and organics

Photo autor

Rys. 3. Duża nieprzepuszczalność zabudowanych centrów jest pierwotną przyczyną istnienia obszarów o podwyższonych ładunkach zanieczyszczeń, które mogą zawierać wiele niebezpiecznych związków organicznych

Zdjęcie wykonane przez autora

ones. In addition large portions of U.S. urban lands are used for traffic corridors. Such categorization is loose and can be hardly correlated with pollution generation. For example, residential areas can range from low density, relatively "clean" residential suburban zones with 1 to 2 houses per hectare, to high density congested urban centers with several hundred people residing on an area of 1 ha. Similarly, industrial zones can include "clean" light manufacturing as well as "dirty" heavy industries such as foundries, smelting operations, steel mills, and mining.

Least pollution originates usually from low density residential zones and park and recreation areas, while the highest pollution loadings can be attributed to high density downtown and industrial centers and, above all, construction sites (fig. 2 and tab. 1).

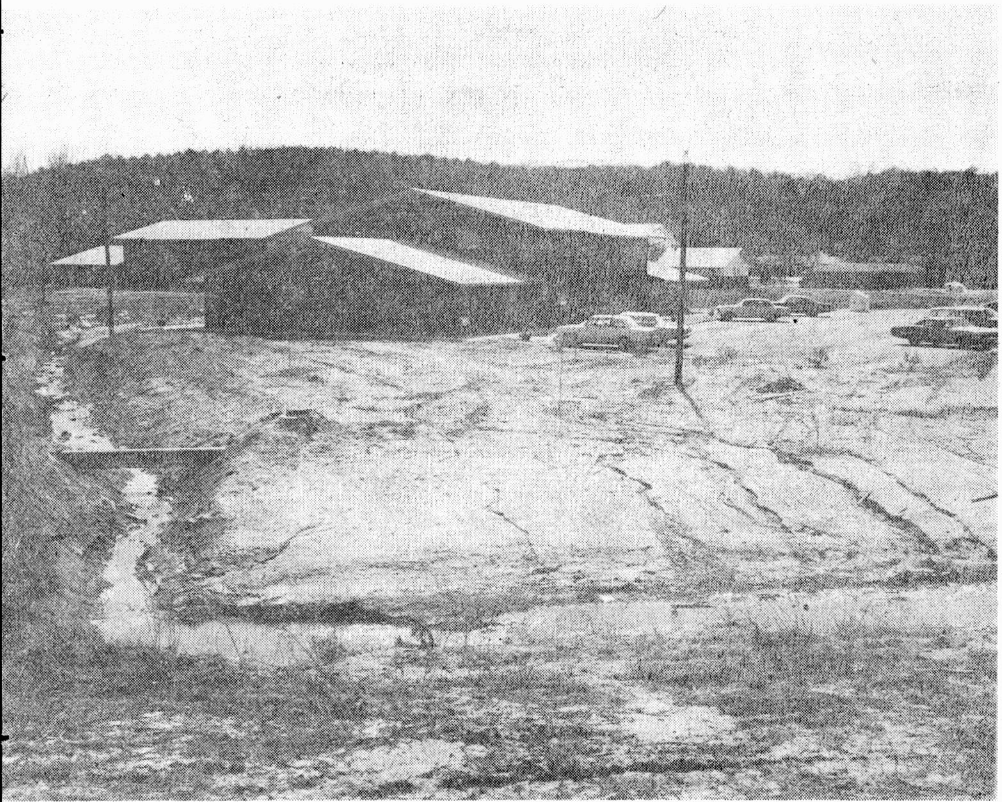


Fig. 4. Highest pollution loadings are commonly measured from lands under development
Photo U.S. Dept. of Agr.-Soil Conservation Service

ys. 4. Największe obciążenia zanieczyszczeniami są zwykle mierzone na obszarach rozwijających się
Fotografia Stanowego Departamentu Ochrony Rolnictwa i Gleby

3. MODELLING OF NONPOINT POLLUTION

Several mathematical models describing pollution generation from nonpoint sources ave been developed in the U.S. in the last 10 years. The purpose and use of these models re primarily for:

A. Estimating magnitudes of nonpoint pollution under different meteorological conitions.

B. Identification of hazardous lands (i.e. sources of surface runoff) throughout the atershed.

C. Evaluation of the effect of various abatement measures on reduction of nonpoint ollution.

The most simple models are based on the Universal Soil Loss Equation (WISCHMEIER nd SMITH [15]). The equation and its development took more than 40 years of experi-

Table

Pollutants associated with street refuse (in μg/g of total solids)
Wskaźniki skażenia spowodowane śmieciami z ulicy (w μg/g całkowitej zawartości substancji stałych

Constituent	Land use			
	Residential	Industrial	Commercial	Transportation
BOD_5	9166*	7500*	8333*	2300**
COD	20822*	35714*	19444*	54000**
Volatile solids	71666*	53571*	77000*	51000**
Total Kjeldahl nitrogen	1666*	1392*	1111*	156**
$P\text{-}PO_4^{\equiv}$	916*	1214*	833*	610**
$N\text{-}NO_3^-$	50*	64*	500*	79**
Pb	1468***	1339***	3924***	12000**
Cr	186***	208***	241***	80**
Cu	95***	55***	126***	120**
Ni	22***	59***	59***	190**
Zn	397***	283***	506***	1500**
Total coliforms, No./g	160000*	82000*	110000*	NR
Fecal coliforms, No./g	16000*	4000*	5900*	925**

* SARTOR et al. [13] – average of several American cities.
** SHAHEEN [14] – Washington, D. C. area.
*** AMY et al. [2].
NR – not reported.

mental field operations gathered by the Agricultural Research Service of the U.S. Department of Agriculture. The USLE was formulated as follows:

$$A = (R)\ (K)\ (LS)\ (C)\ (P),$$

where

A is computed soil loss in tons/ha for a given storm,
R is rainfall energy factor,
K is soil erodibility factor,
LS is slope length factor,
C is cropping management factor, sometimes also called vegetative cover factor
P is erosion control practice factor.

The methods of estimating the pertinent factors of the USLE have been published in several engineering handbooks (e.g. NOVOTNY and CHESTERS [11]).

More complex models are based on the description of the watershed hydrology and sediment transport. Examples of such models include HSP (Hydrocomp Simulation Program) developed by Hydrocomp, Inc in Mountain View, Ca. or model LANDRUN developed by the Marquette University for the International Joint Commission U.S.A.–Canada

The most advanced models simulate the following processes:

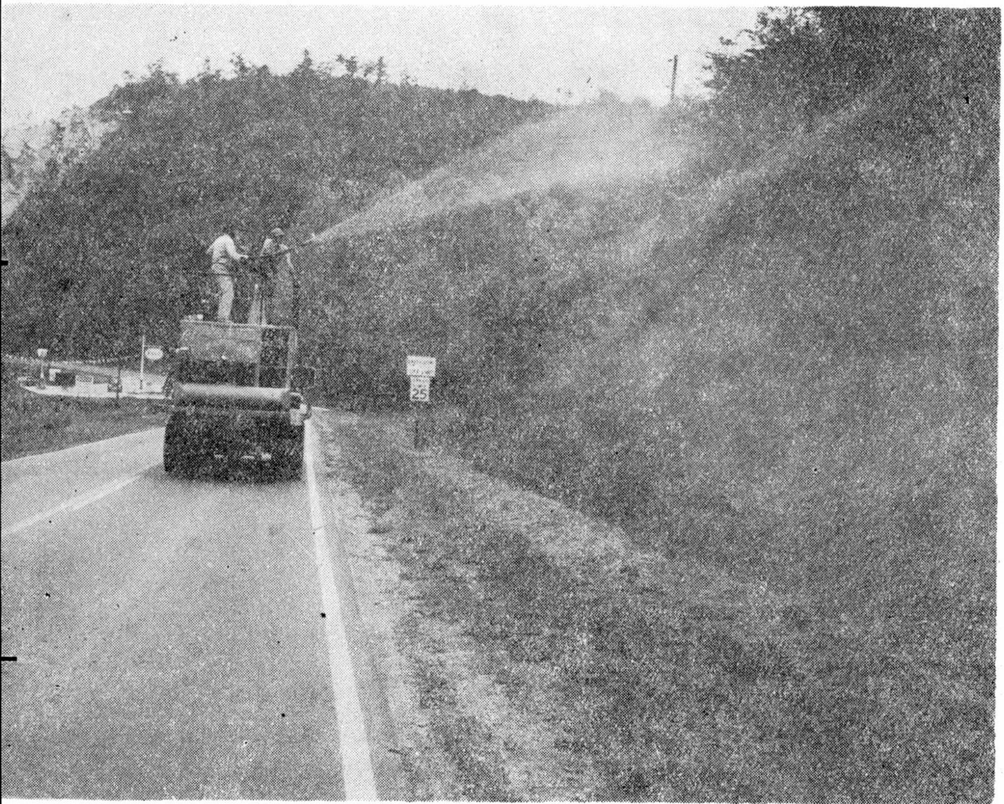
a) formation of surface runoff from rainfall,

b) infiltration,

c) interception and groundwater runoff contribution,
d) snowmelt,
e) sediment generation from the pervious lands of the watershed subject to various ıanagement practices,
f) pollution accumulation on impervious surfaces and its washoff by rain,
g) effect of street cleaning practices on pollution reduction on impervious surfaces,
h) soil adsorption and transformation of pollutants.

Figure 6 shows a block diagram of a mathematical model developed for nonpoint ollution simulation from urban areas.

Most of the advanced nonpoint pollution generation models represent medium to ırge size computer software packages, however, use of models in planning pollution abateıent measures is mandatory. Data obtained from monitoring are limited by time and locaon and may not provide representative loading figures under adverse and statistically rare



ig. 5. Hydroseeding is one of the most effective methods of restoring protective vegetative cover on highly erosive areas

Photo U.S. Dept. of Agr.-Soil Conservation Service

ys. 5. Rozpylanie wody wraz z nasionami jest jedną z najbardziej efektywnych metod przywrócenia ochronnego pokrycia roślinnego na obszarach silnie zerodowanych

Fotografia Stanowego Departamentu Ochrony Rolnictwa i Gleby meteorological conditions. The best use of monitoring data is for calibration and verific tion of the models. Use of models that have not been calibrated and verified by field da is suspect and should be avoided.

4. MANAGING NONPOINT POLLUTION

Nonpoint pollution control measures are diversified and no uniform control technolo can be proposed to control diffuse sources. The traditional means of control—collectio and treatment—which works well for most point sources, would be prohibitively expensi for nonpoint pollution control and could be used only in rare cases when all other contro at the source fail.

It is also not possible to control all pollutants and/or all lands. Practices must be as gned—in a priority order—to the most hazardous lands, i.e. lands generating the large pollutant loads to surface waters. Furthermore, the pollutants to be removed or controll should be those of greatest concern in preserving the quality of surface waters and wh violate the water quality standards.

In general, control measures can be divided into:

1. Source control of hazardous lands and land uses.
2. Collection control and reduction of pollutants delivery to receiving waters.
3. Treatment of runoff.

Control methods can be also grouped into structural and nonstructural—called *Ma gement Practices*. Structural methods include sedimentation basins, seepage beds, treatme facilities, etc., while nonstructural methods rely on better management of agricultu fields, rotation of crops, seeding and soding, air pollution control, street cleaning, e The basic philosophy behind the selection of best nonpoint pollution management practic states that the materials which belong to the land should be kept there. Once the materi begin to move with runoff or soil water their control is more tedious and expensive.

As stated previously, pollution loads vary depending on land use activities in the a and usually only a portion of the basin can be considered hazardous. For example, Bla Creek (Ohio) studies (GROSZYK [6]) indicate that treating 32 ha of the most highly e sive areas rather than the entire 770 ha of an experimental watershed would reduce to sediment load by 40%. In a small suburban watershed located in Milwaukee, Wisc., 2.6 of the total area which was under construction at the time of investigation contribu almost 40% of the sediment loading measured at the river mouth (KONRAD et al. [7 Similarly, most of the lead originated from transportation corridors and other areas w heavy traffic while the lead contribution from rural lands was negligible.

4.1. URBAN LANDS

Urban stormwater runoff is highly variable and its quality as well as that of sno melt often approaches treated sewage or may even be worse. LOEHR [9] reported t loadings from urban nonpoint sources were 220 to 310 kg/ha-year of COD, 30-50 kg/

year of BOD_5, 7 to 9 kg/ha-year of N, and 1.1 to 5.9 kg/ha-year of total P. In addition urban stormwater contains very high concentrations of bacteria (mostly of nonhuman origin) and other pollutants. Table 3 shows sources of nonpoint pollution from urban areas.

Table 3

Sources of nonpoint pollution from urban residential and commercial areas (NOVOTNY and CHESTERS [11])

Źródła niepunktowego skażenia z miejskich mieszkaniowych i handlowych obszarów (NOVOTNY i CHESTERS [11])

Category	Parameters	Potential sources
Bacterial	Total coliforms, fecal coliforms, fecal strepto-cocci, other pathogens	Animals, birds, soil bacteria, (humans)
Nutrients	Nitrogen, phosphorus	Lawn fertilizers, decomposing organic matter (leaves and grass clippings), urban street refuse, atmospheric deposition
Biodegradable organics	BOD, COD, TOC	Leaves, grass clippings, animals, street litter, oil and grease
Organic chemicals	Pesticides, PCBs	Pest and weed control, packaging, leaking transformers, hydraulic and lubricating fluids
Inorganic chemicals	Suspended solids, dissolved solids, toxic metals, chloride	Erosion, dust and dirt on streets, atmos-pheric deposition, industrial pollution, traffic, de-icing salts

The management practices for urban residential and commercial areas and their selection depend on population density and degree of imperviousness of the area. In areas where a large portion of the pollutants originate from pervious surfaces, soil conservation may be the best method to reduce pollutant loads. Common street cleaning practices may not be effective, although the general clean-up of leaves and grass clipings could prevent or reduce large loads of organics to receiving waters.

In low density urbanizing areas the quality of stormwater runoff is handled most efficiently by systems incorporated during development, such as zoning (e.g. limited development on hazardous lands), better architectural concepts utilizing more pervious area and natural drainage in urban zones, increased perviousness and optimal design of stormwater conveyance systems. In high density developed areas, runoff is handled by good street cleaning practices and one of a series of treatment methods subsequent to collection.

Other remedial measures that have been proposed for controlling pollution by urban runoff include increasing the fraction of pervious areas and reducing the proportion of of impervious areas directly connected to surface drainage or sewer systems, installing pervious pavements and disconnecting roof drains from storm or combined sewers.

Management practices of industrial areas must be focused on air pollution and its reduction and on general clean-up measures. In many cases, contamination of surface deposits in industrial areas is of such magnitude that the entire surface runoff must be collected and treated in a plant. Special measures must be undertaken in mining areas to control acid and saline drainage waters.

4.2. POLLUTION CONTROL FROM CONSTRUCTION SITES

Construction sites, in general, produce the highest amount of pollutants ranging up to 50 000 tons/km^2-year of sediment particles with corresponding high amounts of other pollutants (PORTS [12]). The principal cause of the high pollution loads arises from stripping top soils and exposing bare soils with no protection (fig. 4). Furthermore, compaction of soils by construction machinery reduces permeability and surface storage of soils and increases generation of surface runoff. Hence construction sites are areas of highest pollution potential and require application of control technologies.

The control practices for construction sites can be divided into two categories: those that require little cost for implementation but require timing and coordination with construction activities; and those that require some financial resources but can be implemented at some time during construction.

No cost practices include: storing excavated materials at a reasonable distance from roadway curbs and drainage channels, limiting access routes to and from the site and rough-grading the site as soon as possible.

Other practices employed to control nonpoint pollution from construction sites include use of protective mulches and sod, frequent street cleaning near the construction and use of siltation basins. Hydroseeding (fig. 6) is an effective and fast method of restoring protective vegetative cover.

All construction sites are hazardous zones requiring control. Frequently, more than 50% of pollution from an urban watershed is caused by a small portion of the basin under development.

4.3. NONURBAN LANDS

Many factors affect pollutant emissions from farm croplands. Pollutants arise from surface runoff (erosion of top soils and irrigation return flow), interflow (mostly tile drainage and leachate of excess irrigation) and groundwater base flow.

A wide range of management practices are available to reduce pollution loads from agricultural lands. These can be categorized as follows:

1. Soil and water conservation practices, including contour plowing, terracing, strip cropping (fig. 7), cover crops and grassed waterways, and runoff diversion.

2 Crop management practices, including conservation tillage, selection of best time for plowing, chisel plowing, minimum or no tillage, and monocropping or alternate meadows.

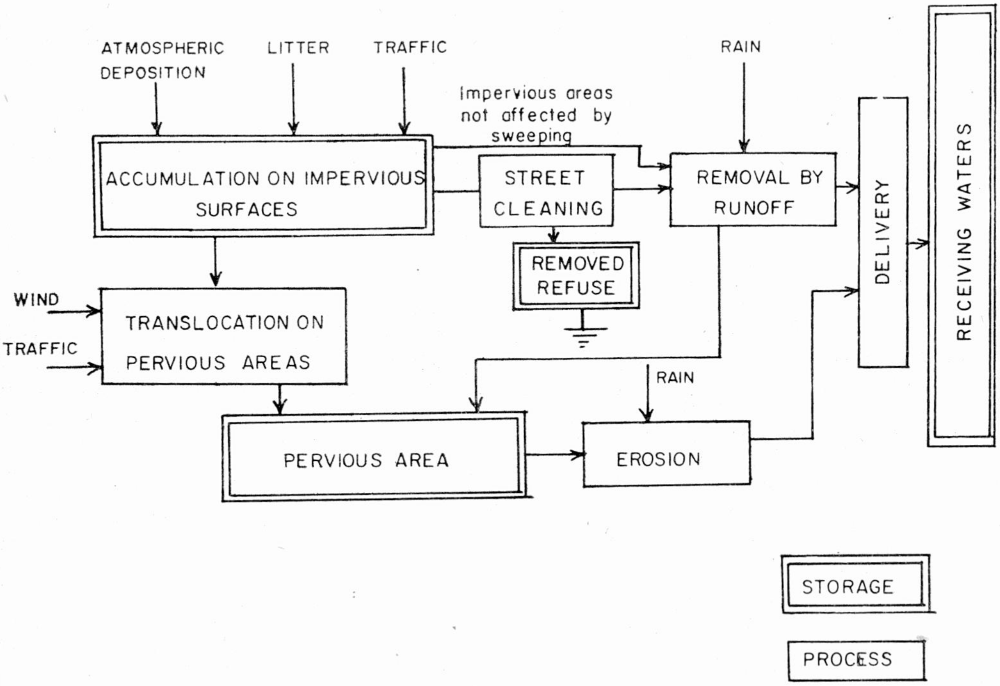


Fig. 6. Block diagram of urban nonpoint pollution generation model
Rys. 6. Blokowy wykres powstawania miejskiego niepunktowego modelu skażeń

3. Nutrient management practices, including fertilizer formulation, application rate, application technique, and timing of application.

4. Pesticide management practices, including application methodology, timing and rate of application, use of degradable compounds, and selection of pest resistant crops.

The most popular method of reducing soil loss and, hence, nonpoint pollution in the United States is use of minimum or no-till planting. Planting is accomplished by placing seeds in the soil without tillage and retaining previous plant residues. The previous planting residues can be killed by herbicides. The plant and root residues provide the necessary surface protection. No-till planting in chemically-killed sod can reduce soil loss (and pollution) to less than 5% as compared to conventional planting and plowing practices. Investigations at Ohio State University (Forster [5]) revealed that no-till practices on well-drained soils may result in greater crop yields and reduction of fertilizer requirements than under conventional plowing techniques. On such soils, no-till planting can be considered as a no-cost very effective management practice.

On poorly-drained soils under reduced tillage crop yields frequently are less than those under conventional tillage practices. Therefore, drainage of the soil largely determines the economical success of reduced till practices.

Feedlots and barnyards are the most hazardous land use in rural areas. The majority of feedlot wastes reaching surface waters are transported by surface runoff. Barnyard and

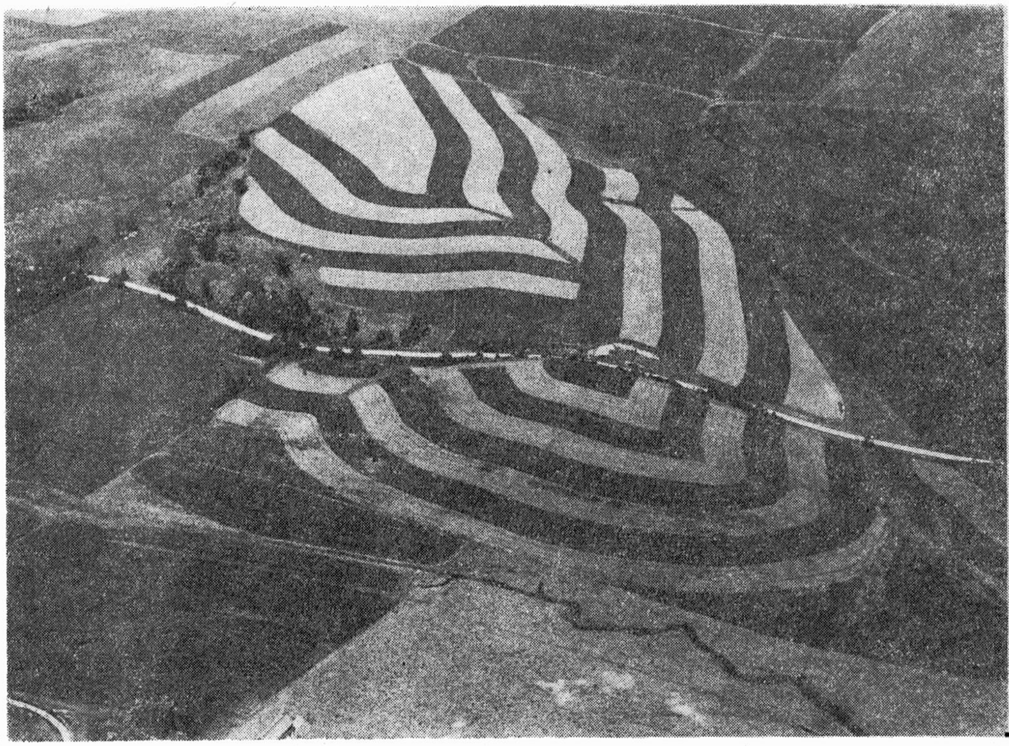


Fig. 7. Contour strip cropping may reduce soil loss and pollution generation by almost 90%

Photo University of Wisconsin

Rys. 7. Konturowe pasmowe uprawy mogą redukować ubytki gleby i powstawanie zanieczyszczeń o szarowych o prawie 90%

Fotografia Uniwersytetu Wisconsin

feedlot runoff has extremely high BOD_5 concentrations (1 000 to 12 000 mg/dm^3); CO concentrations (1 000 to 38 000 mg/dm^3); 6 to 800 mg/dm^3 of organic N and 4 to 15 mg/dm of P (LOEHR [8]). Runoff from barnyards is turbid and represents a high nutrient, sho term (shock) loading to receiving waters.

Control of barnyard effluents may be based on simple management techniques eve though BOD and nutrient concentrations are high. Runoff control systems for feedlo are governed by two basic principles (MADISON et al. [10]). First, all clean water originati outside the feedlot should be diverted so that it does not come in contact with feedlot po lution. Second, the water originating inside the feedlot should be disposed in a way th minimizes its pollution potential (fig. 8).

Vegetative filters and infiltration combines the containment and disposal of barnya or feedlot runoff control. The ratio of pollutants delivered to a watercourse to the amou generated at the source decreases rapidly with the overland distance the runoff must trav At a certain distance—estimated between 30 to 120 meters—this ratio drops almost to ze (MADISON et al. [10]).

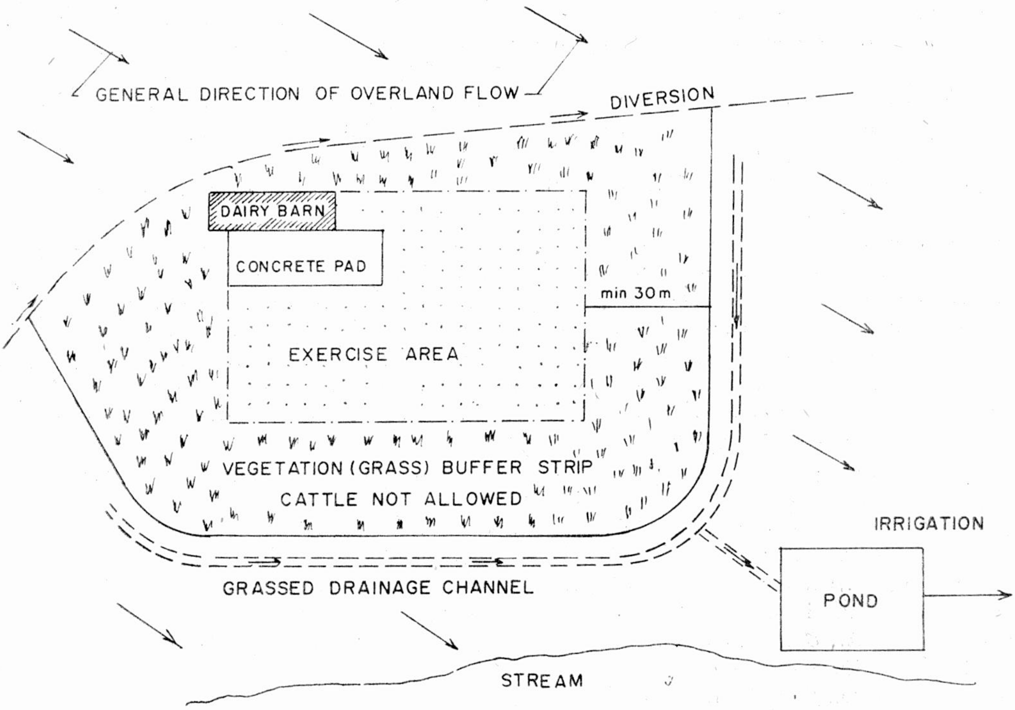


Fig. 8. Example of *Best Management Practices* for barnyards and feedlots (MADISON et al. [10])
Rys. 8. Przykład najlepszych praktyk kierowania ochrony przed zanieczyszczeniem z zabudowań gospodarskich i ferm (MADISON et al. [10])

5. SUMMARY AND CONCLUSIONS

Nonpoint pollution accounts for more than 50% of the total water quality problem. But until very recently it went unnoticed. Beside the traditional pollution parameters such as BOD and Dissolved Oxygen nonpoint pollution involves primarily the sediment pollution and its control, nutrients, toxic metals and organics, and acidity.

In spite of the broad scope of the problem the control methods, called the *Best Management Practices*, are rather simple, often at no or minimal cost. The control method include soil conservation practices, urban street sweeping and general clean-up, air pollution control, and architectural concepts incorporated into the development of the urban areas. Collection and treatment of nonpoint pollution is prohibitively costly and can be used only in few rare instances.

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IDENTYFIKACJA I ZARZĄDZANIE OBSZAROWYMI ŹRÓDŁAMI ZANIECZYSZCZEŃ

Zanieczyszczenia obszarowe są odpowiedzialne za ponad 50% problemów w ochronie wód. Jak dotąd były one jednak niezauważane i główne wysiłki zmierzały w kierunku kontroli punktowych źródeł zanieczyszczeń. Zanieczyszczenia obszarowe można powiązać ze sposobem zagospodarowania terenu. Przedstawione w pracy metody najlepszej kontroli przestrzennych źródeł nastawione są głównie na zatrzymanie potencjalnych zanieczyszczeń na lądzie, a nie na tradycyjne gromadzenie i oczyszczanie.

IDENTIFIZIERUNG UND BEWIRTSCHAFTUNG VON NICHT PUNKTARTIGEN VERSCHMUTZUNGSQUELLEN

Die nicht punktartigen Verschmutzungen betragen mehr als 50% der globalen Gewässerlast. Vor kaum zu langer Zeit widmete man diesem Problem nur kleine Aufmerksamkeit und das gesamte Handeln und Vorbeugen war auf die Kontrolle der Punktverschmutzungen ausgerichtet. Nicht punktartige Verschmutzungsquellen korrelieren mit der landwirtschaftlichen Bewirtschaftung und mit den störenden Tätigkeiten auf dem Boden. Beste Bewirtschaftungsmethoden konzentrieren sich nunmehr auf der Bindung und Immobilisierung verschiedener Schmutzstoffe im Boden, anstatt diese traditionsgemäß zu sammeln und zu reinigen.

ИДЕНТИФИКАЦИЯ И ОСВОЕНИЕ НЕТОЧЕЧНЫХ ИСТОЧНИКОВ ЗАГРЯЗНЕНИЯ

Неточечное загрязнение составляет 50% полного загрязнения воды. Однако до недавнего времени оно было незамеченным и все усилия, связанные с борьбой с загрязнением были направлены на контроль за точечными источками загрязнения. Неточечное загрязнение может быть взаимосвязанным с использованием грунта вместе с нарушающими действиями, происходящими на земле. Наилучшие методы благоустройства сосредоточиваются главным образом на сохранении потенциальных поллутантов в земле в отличии от традиционного накопления и очистки.